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Trichomycterus alterus (Marini, Nichols & La Monte, 1933) and *T. corduvensis* Weyenberg 1877 (Siluriformes: Trichomycteridae): new records from the High Andean Plateau

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Abstract: New records of two *Trichomycterus* species are herein added to the existing checklist of catfishes living at elevations above 3,000 m in the Andes of South America. *Trichomycterus alterus* and *T. corduvensis* are recorded at 3,430 m above sea level from the High Andean Plateau (or Puna) in a stream near Antofagasta de la Sierra, Provincia de Catamarca, Argentina. Morphometric and meristic data of examined specimens are included.

Key words: catfish; high altitude; Argentina; Catamarca; Central Andes; Puna

The Andean ichthyofauna is miniscule (around 375 spp.) compared to that of the South American lowlands (6,000+ spp.) (Schaefer 2011; Fernandez & Vari 2012; Reis et al. 2016). The depauparate ichthyofauna from above 3,000 m in the Andes consists mainly of 34 species of Trichomycteridae, 22 of which occur on the High Andean Plateau or Puna (Arraya et al. 2009; Fernandez 2013). The Puna of the Central Andes is the second largest and highest plateau on the Earth after the Tibet Plateau. It is the prominent feature that characterizes the Andean mountain range along the western border of South America (Aramayo et al. 2017). The high-elevation Puna Plateau extends from southwestern Peru through western Bolivia and into Chile and northern Argentina; it has a relatively long dry season (Ramos 1999; Risse et al. 2013; Becker et al. 2015). The Puna includes endorrheic drainage such as lakes Titicaca and Poopó, and numerous small high-altitude freshwater lakes and swamps, as well as extensive salars such as Coipasa-Uyuni in Bolivia and Antofalla, Hombre Muerto, and Salinas Grandes in Argentina (Kraemer 1999; Schaefer 2011; Ducea et al. 2013; Fernandez 2013).

According to Arratia et al. (1983), Fernandez (2001), Fernandez & Vari (2002), and Arraya et al. (2009), the highest altitude populations of *Trichomycterus alterus* (Marini, Nichols & La Monte, 1933) and *T. corduvensis* Weyenberg 1877 were found at 2,500 m and 1,500 m respectively. Based on new records from a stream in Antofagasta de la Sierra, we report *T. alterus* (Figure 1A) and *T. corduvensis* (Figure 1B) 930 m and 1,930 m higher, respectively, than previously known (Figure 2).

The ichthyological collection of Facultad Ciencias Exactas y Naturales, Universidad Nacional de Catamarca, Catamarca, Argentina (FACEN) was revised. Six specimens of *Trichomycterus alterus* and eight of *T. corduvensis* were identified based on comparisons with type material (for *Trichomycterus alterus*; type material of *T. corduvensis* is missing), the original descriptions, and additional specimens listed below. Measurements to the nearest 0.01 mm were made using a digital caliper following Tchernavin (1944) and Fernandez & Vari (2012). Institutional acronyms follow Sabaj Pérez (2016). In examined material, the number

Figure 1. *Trichomycterus alterus* and *T. corduvensis* from Antofagasta de la Sierra, Catamarca, Argentina. **A.** *T. alterus*, FACEN 0094, 39.7 mm SL. **B.** *T. corduvensis* FACEN 0095, 42.8 mm SL from Antofagasta de la Sierra Department, Catamarca, Argentina. Scale bar = 2 mm.

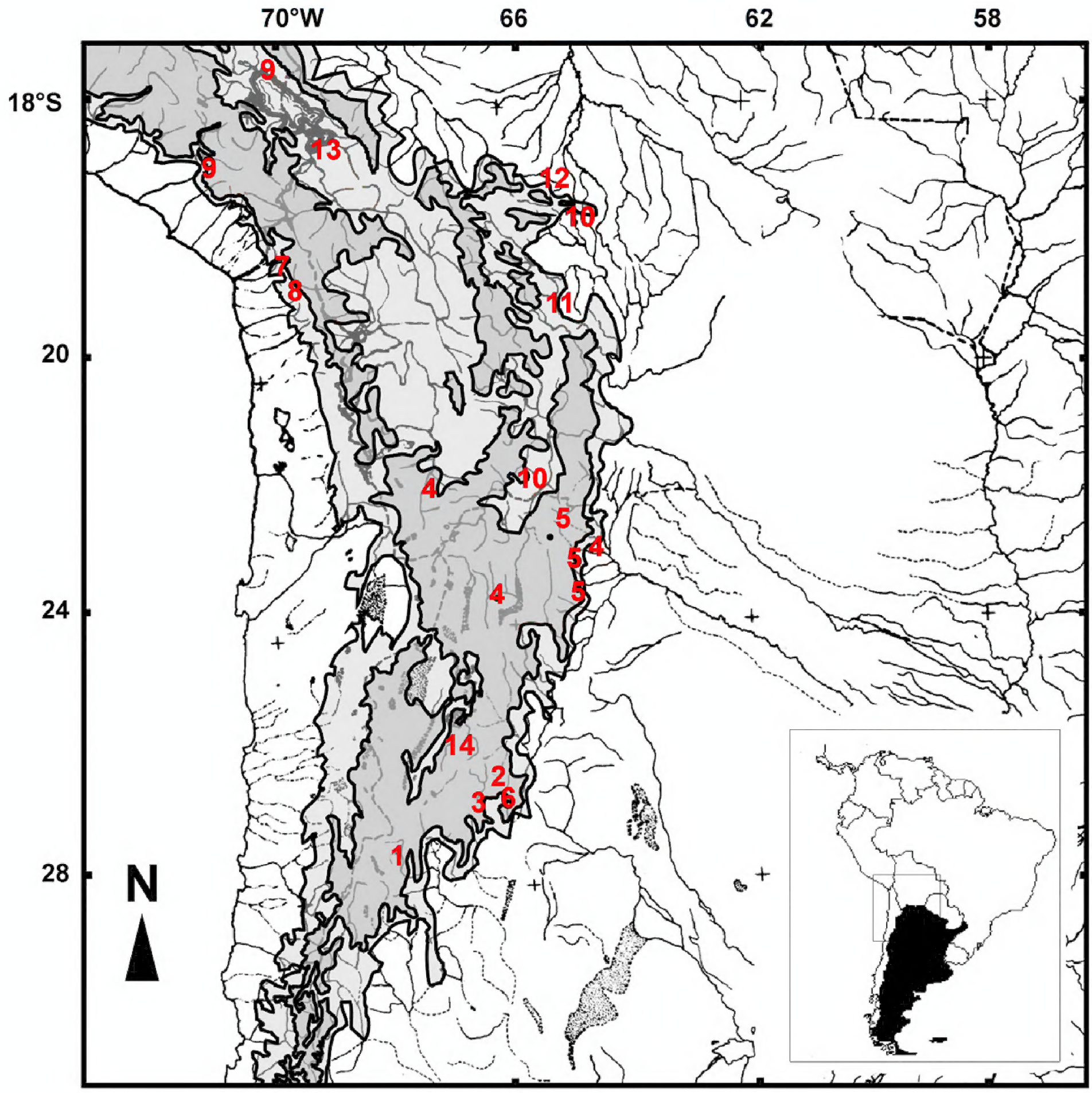

Figure 2. Map of *Trichomycterus* spp. modified from FERNANDEZ & SCHAEFER (2003). 1: *T. yuska*, 2: *T. ramosus*, 3: *T. catamarcensis*, 4: *T. roigi*, 5: *T. boylei*, 6: *T. belensis*, 7: *T. chungaraensis*, 8: *T. laucaensis*, 9: *T. rivulatus*, 10: *T. duellmani*, 11: *T. therma*, 12: *T. tiraquae*, 13: *T. dispar*, 14: *T.corduvensis* and *T. alterus* (26°01′57.09″ S, 067°26′54.51″ W, 3,430 m above sea level). Light shading: elevations above 3,000 m; dark shading: elevations above 4,000 m.

Figure 3. Habitat of *Trichomycterus alterus* and *T. corduvensis* in Antofagasta de la Sierra, Catamarca, Argentina.

of specimens indicated refers to those examined for this study, not necessarily to the total number in lot.

Examined material. *Trichomycterus alterus*: FACEN 0094, 6 specimens, 33.2–42.54 mm SL, unnamed stream near to Laguna Colorada, Departamento Antofagasta de la Sierra, Provincia Catamarca, Argentina, 26°01′57.09″ S, 067°26′54.51″ W, 3,430 m above sea level, 7 July 2016. *T. corduvensis*: FACEN 0095, 9 specimens (1 cleared and stained), 31.6–42.8 mm SL, same data as above. Comparative material: *T. alterus* AMNH 12241, holotype; AMNH 12242, 3 paratypes; FACEN 0088, 1 specimens (cleared and stained); FML 2085, 3 specimens (1 CS); USNM 364373, 3 specimens. *T. corduvensis* FACEN 0081, 4 specimens; FML 2097, 1 specimen (CS); FML 2816, 3 specimens.

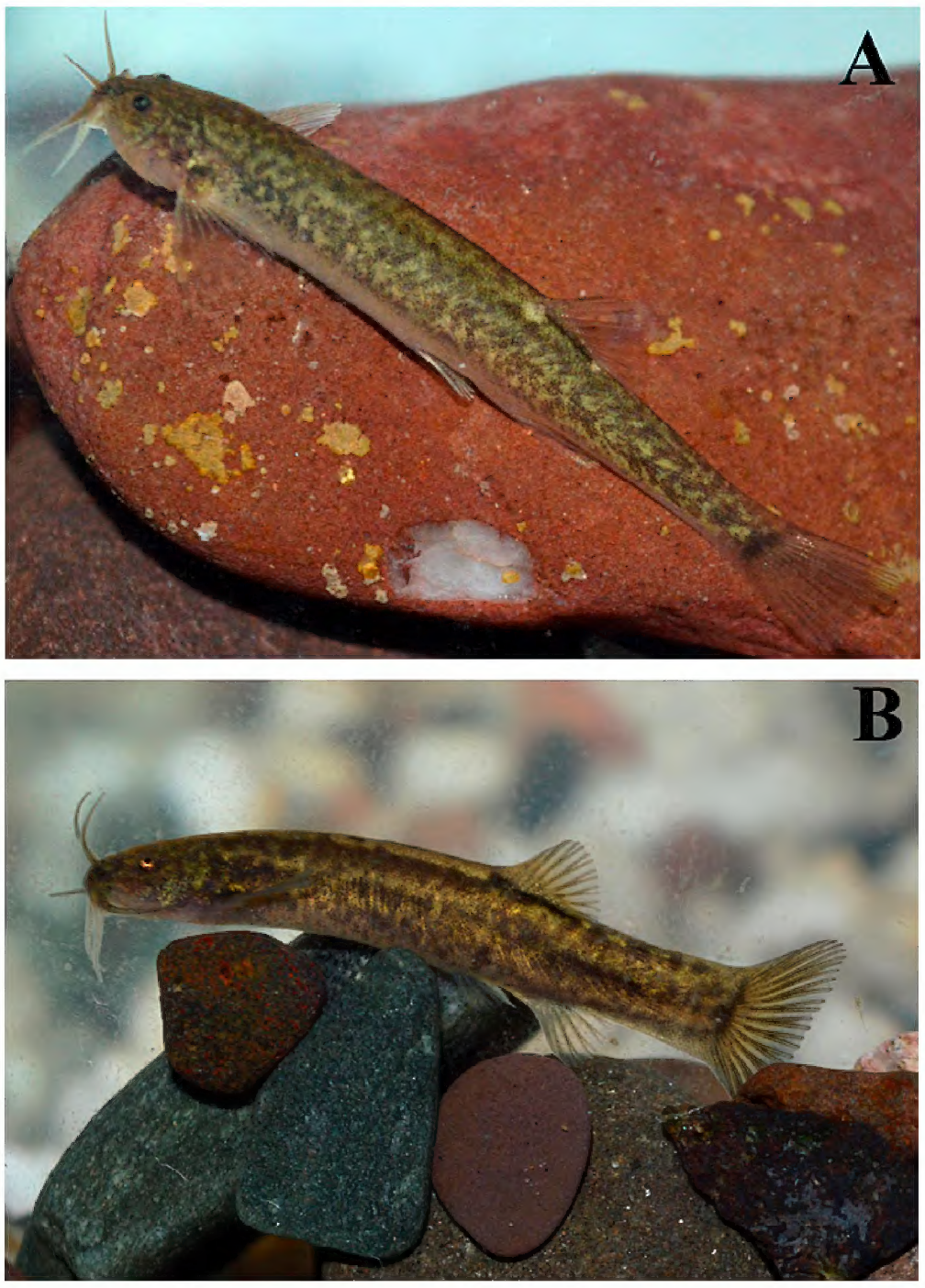

Figure 4. Specimens of *Trichomycterus* spp. from Antofagasta de la Sierra, Catamarca, Argentina in aquarium. **A.** *T. alterus* and **B.** *T. corduvensis*.

Table 1. Morphometric and meristic data for *Trichomycterus alterus* ($n = 6$) FACEN 0094, collected in Catamarca province, Argentina.

Character	Range	Mean	SD
Standard length (mm)	33.2–42.5	36.4	4.5
Head length (mm)	6.1–8.0	6.8	1.0
Percents of standard length			
Body depth	15.2–18.2	16.6	1.1
Caudal peduncle length	24.5–28.2	26.5	1.4
Caudal peduncle depth	9.3–11.5	10.6	0.8
Predorsal length	61.1–64.7	62.5	1.3
Preanal length	64.2–67.5	66.2	1.2
Prepelvic length	49.0–53.0	51.4	1.6
Dorsal-fin base length	9.5–12.6	11.0	1.2
Anal-fin base length	6.3–8.8	7.7	0.9
Head length	18.4–19.6	18.9	0.5
Head width	19.2–22.0	20.5	1.0
Head depth	13.0–14.1	13.5	0.4
Percents of head length			
Interorbital width	27.7–33.3	30.4	2.1
Snout length	33.9–42.6	39.9	3.3
Nasal barbel length	30.9–51.8	39.4	7.2
Maxillary barbel length	46.8–80.5	60.4	11.2
Rictal barbel length	27.5–57.9	39.9	10.1
Mouth width	31.4–41.0	37.8	3.6
Eye diameter	11.5–13.9	12.3	0.9
First pectoral-fin ray length	84.8–98.9	93.5	5.1
Counts			
Dorsal-fin ray		11–12	
Anal-fin ray		8–9	
Pectoral-fin ray		7–8	
Pelvic-fin ray		5	
Caudal-fin ray		12	

The specimens of *T. alterus* (Figure 1A) were recognized by the following combination of characters: caudal peduncle narrow and laterally compressed; dorsal-fin origin unpigmented (Figure 4A); interopercular and opercular odontodes embedded in a thick integument; premaxilla with 2 or 3 rows of teeth; 12 principal caudal-fin rays and distal margin concave; maxillary barbel expanded basally; 6 to 9 branched dorsal-fin rays; 7 or 8 pectoral-fin rays, with small filament; 5 branched anal-fin rays (Fernandez & Vari 2002). Additional features include: supraorbital canal segment discontinuous, with pores s1, s2, s3, and s6 present and laterosensory canal of trunk with 3 pores anteriorly (LF pers. obs.). Morphometric and meristic data is presented in Table 1.

The *T. corduvensis* (Figure 1B) specimens were recognized by the following combination of characters: caudal peduncle smoothly continuous with dorsal and ventral profiles of trunk; papillae-like structures present on body; unpigmented region on the dorsal-fin origin absent (Figure 4B); interopercular and opercular odontodes not embedded in thick integument; premaxilla with 4 to 6 teeth rows and distal portions of teeth in each jaw flattened and slightly expanded; 13 principal caudal-fin rays with distal margin straight (Fernandez 2001). Additional features include: supraorbital canal segment continuous, with pores s1, s2 and s6 present and laterosensory canal of trunk with 4 to 6 pores anteriorly; and supraorbital tendon-bone straight (LF pers. obs.). Morphometric and meristic data is presented in Table 2.

Trichomycterus alterus and *T. corduvensis* inhabit the Río de la Plata basin, in northwestern and central Argentina and the Amazonas basin, at western of Bolivia (Fernandez 2001; Fernandez & Vari 2002; Arraya et al. 2009) (Figure 5). However, they were not collected in high altitudes until now. Several genera of trichomycterid catfishes are endemic to the Andean Cordillera, such as *Silvinichthys* Arratia, 1998 (Argentina), *Hatcheria* Eigenmann, 1909 (Argentina and Chile), *Rhizosomychthys* (Miles, 1942) (Colombia), as well as many undescribed species of *Trichomycterus* Valenciennes, 1832 (Fernandez 2013; Fernandez et al. 2014; Reis et al. 2016). Trichomycterid catfishes are highly specialized for life in uplands along the Andean mountains, and they occur in a remarkable variety of environments, including temporary streams, subterranean drainages, high elevation streams, and warm thermal water (Fernandez & Vari 2012). They generally are equipped with opercular and interopercular odontodes that can be everted to provide friction when these fishes climb waterfalls (Zuanon & Sazima 2005; Fernandez 2013). Although some *Trichomycterus* species can occur at altitudes up to about 4,800 m (*T. roigi* Arratia & Menu-Marque, 1984), they become scarce at high elevations (Fernandez 2013).

Among the 13 described trichomycterids known from the High Andean Plateau (i.e., at or above 3,000 m) are: *T. belensis* Fernandez & Vari, 2002, *T. boylei* (Nichols, 1956), *T. catamarcensis* Fernandez & Vari, 2000, *T. chungaraensis* Arratia, 1983, *T. dispar* (Tschudi, 1846), *T. duellmani* Arratia & Menu-Marque, 1984, *T. laucaensis* Arratia 1983, *T. ramosus* Fernandez 2000, *T. rivulatus* Valenciennes, 1846, *T. roigi*, *T. therma* Fernandez & Miranda-Chumacero 2007, *T. tiraquae* (Fowler 1940), *T. yuska* Fernandez & Schaefer, 2003 (Figure 2), as well as about nine undescribed species (Fernandez & Schaefer 2003; Arraya et al. 2009; Fernandez & Vari 2012; Fernandez 2013).

Table 2. Morphometric and meristic data for *Trichomycterus corduvensis* (*n* = 8) FACEN 0095, collected in Catamarca province, Argentina.

Character	Range	Mean	SD
Standard length (mm)	31.6–42.8	35.1	3.6
Head length (mm)	7.1–9.1	7.7	0.6
Percents of standard length			
Body depth	16.5–21.5	19.5	1.7
Caudal peduncle length	20.0–22.5	21.0	0.7
Caudal peduncle depth	11.7–13.4	12.7	0.6
Predorsal length	60.3–67.2	64.6	1.9
Preanal length	65.1–72.0	69.5	2.1
Prepelvic length	55.2–59.4	56.9	1.4
Dorsal-fin base length	11.9–15.9	13.9	1.6
Anal-fin base length	8.7–12.3	10.1	1.3
Head length	20.4–23.6	22.0	1.0
Head width	20.8–22.5	21.6	0.6
Head depth	13.0–15.0	14.0	0.7
Percents of head length			
Interorbital width	27.9–34.3	31.7	2.1
Snout length	42.4–47.5	45.0	1.6
Nasal barbel length	36.3–63.1	50.5	9.1
Maxillary barbel length	47.0–74.6	56.9	8.1
Rictal barbel length	31.1–43.7	37.4	4.5
Mouth width	40.2–47.7	43.1	2.5
Eye diameter	11.5–14.3	12.7	0.9
First pectoral-fin ray length	67.2–77.4	73.7	3.6
First anal-fin length	64.4–95.7	79.5	9.7
Counts			
Dorsal-fin ray		10–13	
Anal-fin ray		9–10	
Pectoral-fin ray		8–9	
Pelvic-fin ray		5	
Caudal-fin ray		13	

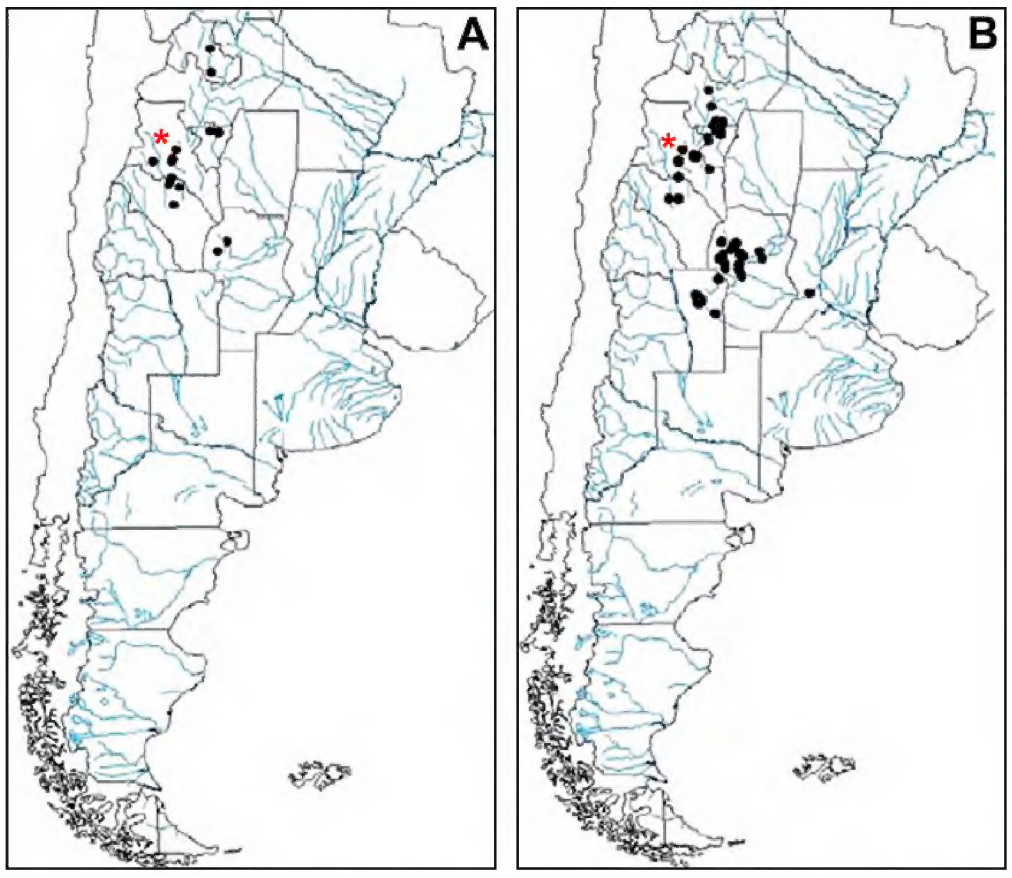

Figure 5. Map of *Trichomycterus* spp. modified from Liotta (2006). **A.** *Trichomycterus alterus* and **B.** *T. corduvensis*. All localities (circle) are below 2,500 m and 1,500 m above sea level, respectively. The new record (asterisk) is at 3,430 m above sea level in Antofagasta de la Sierra.

This is the first record of *T. alterus* and *T. corduvensis* at high elevations (3,430 m) and increases to 15 the number of *Trichomycterus* species known from the High Andean Plateau (Figures 2). In Puna, the overexploitation of natural resources (mainly mining: mountain top valley-fill and lithium) and the introduction of exotic fishes (as Rainbow Trout) endangers many species, especially Andean catfishes (Fernandez 2005; Fernandez & Vari 2012; Habit et al. 2015). Unfortunately, the Argentine government has strong conservation policies directed to the protection of salmonids and catfishes are largely ignored (Fernandez 2005, 2013). On the other hand, it is difficult to provide reliable conservation recommendations for Andean catfishes when data—geographic distributions—are deficient (Fernandez et al. 2014, 2017). Presently, contributions such as these new records are necessary for the establishment of protected areas and promotion of conservation programs in the High Andean Plateau.

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